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The Current Status of Contributing Factors to the Digital Divide

Jennifer Lyn Blakley
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Jennifer Lyn Blakley entitled "The Current Status of Contributing Factors to the Digital Divide." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Economics.

Don Bruce, Major Professor

We have read this thesis and recommend its acceptance:

Robert Bohm, Rudy Santore

Accepted for the Council:
Dixie L. Thompson

Vice Provost and Dean of the Graduate School

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Linda Painter
Interim Dean of Graduate Studies

(Original signatures are on file with official student records.)

The Current Status of Contributing Factors to the Digital Divide

A Thesis Presented for a Master of Arts Degree

The University of Tennessee, Knoxville

Jennifer Lyn Blakley

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Abstract

This study provides a current examination of the contributing factors to the Digital Divide. Breaking this divide down into three distinctly separate models –home computer ownership, home Internet access, and home broadband Internet access – provides the opportunity to see the effect of numerous independent variables on each aspect of the divide. Data from the Census Bureau's Current Population Survey (CPS) for 2000, 2001, and 2003 further provides the opportunity to see if, and how, the divide changes over time. The results show that the divide has decreased with respect to computer ownership and shows little improvement with respect to home internet access. Meanwhile, the results provide no conclusive evidence in any shifts to the digital divide with respect to home broadband Internet access.

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Introduction

Internet access tax moratoriums remain at the forefront of current legislation, while less well known is the parallel pursuit for universal domestic broadband Internet access.[1] Even with similar equal opportunity principles driving each of these quests, access tax moratoriums are consistently approved by the House, Senate and White House while broad knowledge about universal domestic broadband Internet access remains virtually nonexistent.[2] The primary reason for this is likely not a result of apathy over the different types of services available to different individuals, but simply that the public is unaware of how a universal broadband system could drive the nation into a new era of growth. Meanwhile, a universal broadband system is quite similar to the domestic interstate system that came into existence in the 1950s. Just as that system delivered ease of accessibility and new growth, so would a universal broadband Internet system deliver the same positive results.

As was the domestic interstate system, where a problem was identified (i.e., complexity of domestic travel), and solved (i.e. through a standard national roadway program), so is the domestic broadband system. The problem such a system would address is known as the Digital Divide, a term first coined by Dr. Simon Moores in the mid-1990's[3]. Although initially this term was intended to address the gap between those who have access to computer and Internet services and those who do not, as technology

[1] Broadband Internet access is defined as an Internet connection with a download speed of more than 56 kilobits per second as found on The Free On-Line Definition of Computing.
[2] The Internet Tax Freedom Act (formerly known as S.442, now Title XI of P.L. 105-277) in 1998 was the first such access tax moratorium, followed by an extension in 2001. In 2004, President Bush signed into effect the Internet Tax Non-Discrimination Act (Pub. L. 108-435), thus providing a new three-year moratorium. Currently there are no less than five bills (H.R. 1684, H.R. 1685, H.R. 4862, H.R. 5422, S. 849) submitted in the House and Senate to make permanent this moratorium on taxing Internet access.
[3] See http://en.wikipedia.org/wiki/Simon_Moores.

improved it began to also encompass the gap between those with broadband Internet and those without. As of 2003, this gap remained substantial with only 19.9% of U.S. households claiming broadband Internet connections (NTIA, 2004).[4] Since 2003, the share of broadband usage has grown consistently, at a rate of 30-40% each year. Although current data regarding total household connections is not available, by 2006 nearly 42% of all American adults have home broadband connections (Horrigan, 2006). Meanwhile, the composition of broadband Internet use among active home Internet users is 68% (Nielsen/NetRatings, 2006). Although the gap between those with broadband connections and those without is unquestionably shrinking, it is useful to consider the characteristics of those with broadband connections to determine if, and how, any government intervention could bring the remainder of the population across the divide. Such government intervention would likely come directly from the Federal Communications Commission, which is instructed by the Telecommunications Act of 1996 (P.L. 104-104), and Section 706 to intervene if it broadband Internet access is not made available to all Americans within a reasonable time frame (Kruger, 2006).

An additional method of garnering attention and government intervention for universal domestic broadband comes from the executive office. Much like President Eisenhower brought to the public's attention the need for an interstate system, so President Bush has attempted to bring to attention the need for a domestic broadband system. In 2004 he stated his goal for universal, affordable broadband access by 2007, with the reasoning being "the more users there will be, the more likely it is America will

[4] In 2004, a report by the Commerce department stated 61.8 percent of US households had computers, 54.6 percent of US households had Internet connections, and 19.9 percent of US households had broadband Internet connections.

stay on the competitive edge of world trade…the more users there are, the more likely it is people will be able to have interesting new ways to receive doctors' advices in the home…the more affordable broadband technology is, the more innovative we can be with education."[5] To correlate this with the terminology used thus far, he specifically wanted to decrease the digital divide in order to increase opportunities and promote growth. Whether this could be done remains to be seen, as there are certainly dissident arguments against the need for domestic universal broadband access. Such arguments include: Internet access is Internet access –thus whether it is broadband or narrowband is insignificant, and Internet access isn't a necessary good (such as public education or public roads) and should be left out of government intervention altogether. Although it is good to look at the different types of arguments, at this time the research seems to refute these dissenting arguments with claims that different types of Internet access fundamentally change the *nature* of activities on the Internet. The most compelling article of this sort is the US Department of Commerce's 2004 report, *A Nation Online: Entering the Broadband Age*, which finds that broadband Internet users more often engage in activities involving information gathering, banking, purchasing and entertainment than do those with dial-up connections (NTIA, 2004).[6] These results also help support the widely argued assertion that individuals with broadband Internet have more opportunities for education and healthcare, have increased opportunity to participate in e-government and civic responsibilities, and have greater access to employment sources than do those with only a narrowband connection (Lopez-Aqueres,

[5] See Remarks by the President on Homeownership, March 2004.
[6] See "A Nation Online: Entering the Broadband Age." US Commerce Department, (2004)

2004). Such research further supports Metcalfe's Law –that is, that the value of a telecommunications network is equal to the square number of people using the network.[7] An additional explanation of Metcalf's Law is that the more users there are on a network, the more beneficial that network is, which will in turn encourage more people to begin using the network.

Stated differently, but following the same idea as Metcalfe's Law, is the idea of a network externality resulting from having more people connected, more often. This network externality is the notion that an increased number of users will necessarily result in increased information or knowledge, or that the value of the network depends on the number of people that can be reached through that network. Taking into consideration that 66% of broadband users access the Internet on a daily basis, as compared to 51% of dial-up users who daily access the Internet, assures us that any network externality would be more fully realized under a universal broadband Internet system rather than under a system where only a select number of individuals are able to have broadband Internet access in their household (NTIA, 2004).

Arguments for and against government intervention are based off research of markets with network externalities. Economides (1996) begins the deliberation by stating that perfect competition will lead to inefficiencies in a market with network externalities. He states that the marginal social benefit is greater than the benefit the firm would receive from expansion, thus a smaller network will be provided than that which is efficient. He further finds that for some high marginal costs, the good will not be provided at all even though it is socially optimal to provide it. For the case of a

[7] See http://www-ec.njit.edu/~robertso/infosci/metcalf.html, http://en.wikipedia.org/wiki/Metcalfe's_law, or http://www.computerhope.com/jargon/m/metcalfe.htm for further explanations of Metcalf's law.

monopoly, he finds that though higher production would result from the monopolist recognizing his influence over consumer expectations, his profit-maximizing tendency will have an even greater influence over the monopolist, resulting in a market with less supply than the perfectly competitive market. Finally, he found that a market identified by an oligopoly or monopolistic competition will supply a network of some size between that supplied by the monopoly and the perfectly competitive firms. Based off earlier work by Economides, George Zodrow (2003) brings government intervention into the discussion. He states that the rational for a government subsidy is that an appropriately designed subsidy can increase the size of the network to the efficient level, provided it is reflects the marginal external benefit of the network expansion. He further clarifies, however, that government intervention is still undesirable if a single firm owns all of the nodes on the network and is able to charge other members for the increased benefits they receive, stating that there is then an inherent incentive for market expansion.

Regardless of the theoretical arguments, the question remains as to how responsive consumers would be to increased government intervention intent on simply increasing supply. The overriding assumption in the argument for this type of government intervention is that this digital divide is an issue caused by a lack of adequate or affordable broadband Internet supply in the market. However, it is necessary to consider that this digital divide isn't completely a supply side issue, and that it is possible that decreased demand is the reason for the market failure –thus rendering future government intervention targeted to increasing supply useless. Therefore, before implementing these government programs intended to diminish this divide, it is necessary to first consider the impetus for such unequal access among the domestic population.

Section I: Methodology

Similar to Fairlie's (2004) model of home computer ownership and home Internet access, I also use a logit model and data from the Census Bureau's Current Population Survey (CPS) to determine the underlying causes of differences in computer ownership and Internet access. However, unlike Fairlie, who was interested in determining if such a divide existed for August 2000, I am interested in assessing what happens to this divide over time, as well as in the additional model for home broadband Internet access. My empirical strategy then is to complete logits for the years of 2000, 2001 and 2003 for home computer ownership, home Internet access and home Broadband Internet access, followed by a comparison of the data to determine any temporal shifts in the divide.[8]

Various government studies have also studied this digital divide, and conclusively determined that proximity to metropolitan areas, race and income strategically play a role in determining the lines in the divide (NTIA, 1999; NTIA 2002; NTIA, 2004). The first such report on the divide, *Falling Through the Net: Defining the Digital Divide* (NTIA, 1999) also used a logistic regression on CPS survey data to monitor changes to the digital divide over time. However, the model in that study is based on a binary dependent variable of public Internet access, rather than home Internet access. Furthermore, although their model is an excellent starting point, my model continues the examination into the 21st century by examining data from 2000, 2001 and 2003. Even yet, it is useful to refer back to their results throughout this paper as their results are distinctly similar with respect to shifts in the digital divide.

[8] Although the Census Bureau began collecting computer ownership data in 1983 and home Internet access data in 1995, I limit those two sets to the same years as the inclusive broadband data for the purpose of a streamlined data set.

As mentioned above, in this study I run a logit model, with a binary dependent variable of computer ownership in the first model, home Internet access in the second model, and home Broadband Internet access in the third model. Each of these logits is used for each of the three years of available data. Running the models for each of the three years further allows us to see how these effects change over time (i.e. how the digital divide shifts temporally). Also, although in the extreme it is true that each model is built off the previous one, where those with broadband Internet access necessarily have home Internet access, and those with home Internet access necessarily own a home computer, I have not completely limited this to be the case. Although the majority of respondents who access the Internet at home do so through a home computer (99.5% of those with home Internet access), there is still a small percentage (.5% of those claiming home Internet access) of respondents who do access the Internet through a mobile phone or other electronic device (NTIA, 2003). Therefore, it is safe to assume that each model is built off the previous one, but without the limitation of excluding portions of the population who do indeed still have Internet access.

In each of my three models, the independent variables remain the same to further facilitate an appropriate comparison. For each case, the chosen variables are similar to Fairlie's (2004), with the exception that I combine several categorical variables into discrete dummy variables, and I include others that he doesn't.[9] Past research has shown that income level and education level are both substantial influencing factors on the

[9] Fairlie's model looks at family income categories of $10,000 to $15,000, $15,000 to $20,000, $20,000 to $25,000 and so on up to include family income of over $75,000, I combine each of these into three categories: household incomes under $20,000, household incomes of $20,000 to $39,000, and household incomes of greater than $40,0000. Similar changes were also made for highest attained education level and region of the country. Highest attained education level was divided into the following three dummy variables: less than a high school education, high school education or equivalent, more than a high school education.

digital divide, with higher income households and higher educated households having increased access to home computers and home internet (NTIA, 1999; Fairlie, 2005). Region of the country was likewise divided into the dummy variables West, Northeast, South and Midwest. Research has shown that households in the Northeast and West have higher broadband rates than the South and Midwest (NTIA, 2004; Fairlie, 2004).

Phone ownership is an independent variable chosen to determine if there is any relationship between those with phone service and those without. As five to six percent of US households have declined telephone service since the 1990's, it is useful to determine if having a phone has a relationship on owning a home computer, having home Internet access, or home Broadband Internet access (NTIA, 2004).

Residential status is determined by a series of dummy variables that represent whether the household owns the home of residence, rents the home of residence, or neither owns nor rents the home of residence. This variable is interesting to determine if residential stability (as represented by home ownership) factors into determining the separating lines of the digital divide.

The number of family members in the household is a continuous variable ranging from one family member to thirteen family members for 2000, one to sixteen family members for 2001, and from one to twelve family members for 2003. Using this variable will help determine, separate from income, whether having more family members increases chances of technological advancement.

The next category of variables, those describing respondent race, is included to determine if the divide with respect to race has shifted over time. Previous research has shown that Black, Hispanic and Native American, and Spanish-speaking respondents are

less likely than White and Asian respondents to have computer and Internet access (NTIA, 1999; NTIA, 2004; Fairlie, 2004), therefore I also include these variables as dummy variables in my model.[10]

Marital status is divided into dummy variables representing divorced respondents, married respondents, never married respondents and widowed respondents. I include these variables to determine if a particular type of marital status has a significant effect on the dividing lines of the digital divide. Past research indicates that single households lag married households in technological advances (NTIA, 1999).

Gender is included as a set of dummy variables, Male and Female, as are metropolitan living status and employment status. Metropolitan living status was divided into dummy variables representing households located in the central city, households balancing on a metropolitan statistical area, households not identified with regard to metropolitan area, and households in a non-metropolitan area. Previous research has shown that metropolitan living status has a significant affect on utilization and availability of electronic services, with those in rural areas significantly behind in the digital revolution (NTIA, 1999; Prieger, 2003) and with no hope for an easy solution to equitable access availability (Grubesic and Murray, 2002). Possible reasons for this are varied. For example, Madden and Simpson (1996) found from a survey on broadband service that broadband subscription *interest* was higher in the metropolitan areas than in the more provincial areas of Australia, but Grubesic and Murray (2002) found instead that lack of access was likely due to technological limitations. There is not quite the same

[10] In the following sections detailing my results, I include in my description of race the variable for whether Spanish is the only spoken language in the household –both because it naturally fits and because it follows the same trends as the minority races.

level of debate over the effect of employment status. Previous research including variables for employment status has shown that unemployed households lag employed households in the digital revolution (NTIA, 1999). I include variables of this sort to determine if I achieve similar results and represent this set of variables as dummy variables for employed, unemployed and not in the labor force.

The following sections detail the analysis of each of the above mentioned independent variables against the dependent variables of home computer ownership (Section II), home Internet access (Section III), and home Broadband Internet access (Section IV).

Section II: Model Results for Computer Ownership

It is necessary to begin this examination into the broadband digital divide by first starting with the initial divide that began attracting the notice of policymakers in the mid-90's—that is, the divide between those who own a home computer and those who do not. It is logical to begin the analysis with this divide for a number of different reasons, the first being that in order to have broadband Internet at home an individual must first have home Internet access, and in order to have home Internet access, in most cases the individual must first own a computer. An additional reason it makes sense to begin at this point is because this portion of the divide began in much the same way as the broadband divide, only it began twenty years before this latter divide. Therefore, by the time of the data I am using in my analysis, it is reasonable to expect dissipation on any preexisting supply side issues, providing a much better demand side analysis into the remainder of the divide. The summary statistics are presented in Table 1.2 and the coefficients, standard errors and marginal effects are presented in Table 2.1 All tables are located in the Appendix.

As shown in Table 1.2, the total number of observations in 2000 was 28,011, with 57.8% of the respondents owning a home computer, and with a predicted probability of 59.5% of respondents owning a home computer. In 2001 the total number of observations was 17,198, with 65.4% of the respondents owning a home computer, and with a predicted probability of 69.6% owning a home computer. By 2003 the total number of observations was 18,283, while 68.8% of the respondents owned a home computer, and the predicted probability was 75.3%. Noting the increasing numbers for

the actual means (57.8%, 65.4% and 68.8%, respectively) shows that the number of households owning a home computer increased by 11 percentage points in the three years of the analysis. For the purpose of this paper, the focus of the data analysis will be on the marginal effects of each variable, as the estimated coefficients in a logit model do not have a direct economic interpretation. The marginal effects represent the change in the probability of owning a home computer as a result in an incremental change of the independent variable, or as a change from "0" to "1" for a dummy variable.

Although the coefficients by themselves are not of any import to this analysis, Table 2.1 is important for assessing the significance of each individual variable at the 10%, 5% and 1% levels. Out of twenty-seven variables, in this model of computer ownership there are twenty variables that are significant at the 1% level and two that are significant at the 5% level. This model provides an excellent starting point for an examination into the digital divide.

I examine the variables pertaining to income first as they were among the largest in explaining this portion of the digital divide. Before running the model, I created the following three brackets: households with annual incomes under $20,000, households with annual incomes between $20,000 and $39,000 and households with annual incomes greater than $40,000. Following that organization of the data, I put the first two groups into the model and leave out the third group as a reference category. The result of this was that not only were these income variables significant at the 1% level for all three years, but also that these variables provided the largest results for increases in the probability of a household owning a home computer during the three years of analysis. For example, having a household annual income of less than $20,000 reduced the

probability of owning a home computer by 35 percentage points in 2000, which when compared with the average computer ownership probability of 58% translates into a 60% difference. The results were nearly identical in 2001, but by 2003 having a household annual income in this bracket only reduced the probability of owning a home computer by 30 percentage points, which when compared with that year's average computer ownership probability of 69% translates into a 45% difference. The fifteen percentage points between the 60% difference in 2000 and the 45% difference in 2003 translates into a decrease in the divide of fifteen percentage points over the three years of analysis.

The above decrease in the digital divide is comparable to the decrease in the divide for the second income bracket. I found here that having a household annual income between $20,000 and $39,000 reduced the probability of owning a home computer by 23 percentage points (40% difference when compared with the average computer ownership probability of 58%) in 2000, 24 percentage points (36% difference when compared with the average computer ownership probability of 65%) in 2001, and still by nearly 19 percentage points (27% difference when compared with the average computer ownership probability of 69%) in 2003. Again, these numbers correspond with a decrease in the divide of 13 percentage points during the three years of our analysis. Although with both of these two cases the divide does slightly decrease with respect to income, the decrease is slight when compared with the overall decreased probability of belonging to one of these two groups.

After income, the next factor that best illustrates the digital divide is the highest level of education the respondent obtained. For these variables, I combined several categories into three dummy variables: highest level of education equal to less than high

school diploma or equivalent, high school diploma or equivalent and greater than high school diploma or equivalent. In this computer ownership model, and as will be later noted with the other two aspects of the digital divide, education plays an integral role in determining who is on which side of the divide. For example, I found as compared to individuals with more than a high school education, individuals with less than a high school education had a decreased probability of owning a home computer of 30 percentage points (52% difference) in 2000. By 2003 this variable showed less of an effect on the probability of owning a home computer, with a decreased probability of 31 percentage points (46% difference). As for individuals who completed high school or the equivalent, they still had a decreased probability of 23 percentage points (39% difference) in 2000 and 21 percentage points (30% difference) in 2003. Both of these education cases show some gain in this portion of the digital divide, with the first case gaining 6 percentage points and the latter case doing slightly better at a gain of 9 percentage points.

The third characteristic that provides insight into the digital divide is race. These variables have, of course, been the most widely documented when discussing the digital divide. Legislatively, the concern is that minority groups which have traditionally been targets of discrimination will fall behind economically and academically without equal access to the digital revolution.[11] The variables in this race category were divided up into the following five dummy variables: White, Black, Native American, Asian and Hispanic. Additionally, due to an obvious similarity to the race variables, I will also include the Spanish-only variable, representing those households where Spanish is the

[11] For more information on redlining as it pertains to the digital divide, please see Prieger (2003).

only language spoken. Prieger (2003) found that, on the supply side of the broadband divide, such households do not have equal access to broadband supply; I look for evidence of the same type in the divide as it pertains to computer ownership. In other literature on the race aspect of the digital divide, concern has primarily centered on Black and Native American households. With respect to the broadband divide, and as will be discussed in Section IV, papers by the Department of Commerce (2004), Prieger (2003) and Robert Fairlie (2004) find that Black and Native American households lag other races in availability of broadband services. I look for similar evidence with these race variables as they pertain to the computer ownership aspect of the digital divide.

The results with these variables show that all are significant at the 1% level for all three years except Asian. As was found in the studies on the broadband divide, the Hispanic population and Black population were the least likely of all included races to own a home computer. As compared to the reference category of White households, I find that Hispanic households had a decreased probability of home computer ownership of 22 percentage points in 2000, which translates into a 38% difference when compared with the average computer ownership probability of 58%. By 2001 there was a positive movement forward as Hispanic households had a decreased probability of 20 percentage points (30% difference when compared with the average computer ownership probability of 65%), and even more with only a decreased probability of 9 percentage points (12% difference when compared with the average computer ownership probability of 69%) by 2003. Meanwhile, Black households experienced a decreased probability of home computer ownership of 16 percentage points (27% difference) in 2000, 17 percentage points (27% difference) in 2001 and 15 percentage points (22% difference) in 2003.

Clearly of these two, although Hispanics were much further behind in the divide in 2000, by 2003 the Black population was the furthest behind. Even yet, I find that the Native American population is slightly behind the Black population, as when compared to the White population, Native American households had a decreased probability of home computer ownership by 19 percentage points (33% difference) in 2000 and 20 percentage points (31% difference) by 2001. Continuing on to the Spanish-only speaking households, I find that those households had a decreased probability of 20 percentage points (34% difference) in 2000 and of 32 percentage points (47% difference) by 2003. Certainly this is cause for consideration as it is the only variable to lose ground this significantly in this portion of the digital divide.

The fourth factor I examine is marital status. Marital status is divided into the following four dummy variables: married, divorced, widowed and never married. Although intuition might suggest marital status would have little to do with owning a computer, I find that it does in fact determine some of the divide. Leaving out the married variable as the reference category, I find that each of the other variables is significant at the 1% level for all three years. Beginning with the households where the respondent is divorced, I find that the divide increases from a reduced probability of 4 percentage points (7%) in 2000 as compared to the married households, to a reduced probability of 6 percentage points (9%) by 2003. The widowed households showed some positive gain in the divide, as in 2000 they were 6 percentage points (11%) less likely than married households to own a home computer, while in 2003 they were only 4 percentage points (7%) less likely. Examination of the never-married respondents finds that those numbers are not quite as promising as these other categories. In 2000 having

never been married reduced the probability of owning a home computer by 7 percentage points (12%) over those households where the respondent was married, but by 2003 this increased to a reduced probability of 11 percentage points (16%).

The last factor I include in my explanation of the model is region of residence. In the model Northeast, South, Midwest and West were all dummy variables. After testing each of these variables against the dependent variable, I found that while each of the results was significant at the 1% level, all variables except West were still rather inconsequential. This variable instead showed that in 2000, those households located in the western region of the United States were 9 percentage points more likely to own a home computer than the reference category (South), which when compared to the average computer ownership probability of 58% translates into a 16% difference. By 2003 the divide with respect to region decreased considerably, increasing the probability of those households in the western region owning a home computer to only 3 percentage points (5% difference) over those households in the southern region.

Each of the above-mentioned results provides an excellent picture of the digital divide with respect to computer ownership. The first obvious conclusion from viewing these results is that there is no doubt about the existence of this digital divide, and while some aspects of it appear to shrink over the time of the analysis, some still show little, if any, improvement. From this analysis of the initial divide, I found that the divide was the largest with respect to income and education level, and though both of these decreased over the three years of the analysis, by 2003 they still remained at the top of determining factors in this portion of the digital divide. These results suggest that households with annual incomes greater than $40,000 and education levels higher than a high school

diploma or equivalent are substantially more likely to need, and own, a home computer than are households where the annual income and education level is less than these levels.

The results also showed that though there was a substantial decrease in the divide with respect to race, White households were still more likely to own a home computer than were Black and Native American households. Also, while Hispanic households showed the largest decrease in the divide in this section, households where Spanish was the only language spoken experienced the largest increase in the divide in this section.

As it turned out, marital status did have a significant effect on determining the existence of the digital divide. This set of variables also experienced an increase in the divide, though by much less than Spanish speaking households. While married respondents were much more likely to have home computers than were divorced, widowed and never married respondents, the divide only shrank with respect to widowed respondents.

Finally, the results showed that region of the country had very little impact on this portion of the divide by 2003, with only the western region having a slight advantage over the southern region.

From these results it is clear that addressing all of the most important variables in this section, income, education, race, and region of residence, is likely unable to be accomplished by a mere tax reprieve or subsidy. Instead, encouraging education or encouraging families to move to areas in the west and northeast are the only viable options shown by the results in this section. The next step then is to determine if similar conclusions result from the analysis of home Internet access.

Section III: Model Results for Internet Access

The next step of this examination of the digital divide is to provide the same type of analysis as was done in Section II on home Internet access rates –and specifically on home Internet access rates without regard to the type of access. Although Section IV will consider the more in-depth look into the divide, here I simply want to see how the same independent variables affect the probability of having any type of home Internet access. This section is particularly interesting because it provides us an idea of the impetus of the divide, as it is the intermediary step between the computer ownership divide that began twenty years ago and the broadband divide which began only about five years ago. As this one is lagged about ten years behind the initial computer divide, I expect it will show a lot of the same features the computer divide model did, only with much more convincing numbers.

As before, I begin my analysis in 2000 in an effort to maintain a streamlined analysis of each aspect of the digital divide. Although the total amount of households with home Internet access is completely different from the total amount of households with home computer ownership, the number of various independent variable observations limits the total number of observations to exactly the same as the number of observations in the previous model. In 2000 the total number of observations included in the logit was 28,011, with 46.2% of the sampled population having home Internet access, while 42.8% were predicted to have Internet access. In 2001 the total number of observations was 18,283, those with home internet access totaled 58% of the sampled population, and the predicted mean was 59.2%. By 2003 the total number of observations was 18,283, 62.4% of those had home Internet access, and 66.4% were predicted to have such access.

A simple glance at the difference in the actual means shows that the number of individuals with home Internet access rose by nearly 20 percentage points over the three years of this analysis. Already this growth in the number of connected households in the years of consideration illustrates the formerly stated position that this market is behind the market for computer ownership, further validating the reasons for looking at the divide from this perspective. The following analysis will focus on the marginal effects of income, education and race. The results from this section are represented in Tables 1.3 and 2.2.

Annual household income provides the most compelling result for a digital divide with respect to Internet access. Additionally, this provides the first notion that perhaps this portion of the divide is not showing the promising decrease as did the divide with respect to computer ownership. For example, whereas in the first model only one variable (Spanish-only) showed a marked decline, already the first variable examined here shows a marked decline in progress on the divide. In 2000 a household with an annual income of less than $20,000 experienced a decreased probability of having home Internet access of 32 percentage points as compared to those households with an annual income of greater than $40,000. When compared with the home Internet access average probability of 46% this translates into a 70% difference. By 2003 households in this income bracket experienced a decreased probability of 36 percentage points, which when compared with that year's average probability of home Internet access of 62% translates into a 59% difference. I found similar results with households where the annual income is between $20,000 and $40,000. Being in this income bracket decreased the probability of having home Internet access by 20 percentage points (44%) in 2000 and by 24

percentage points (39%) by 2003, relative to those households earning greater than $40,000. Although we see that in the first case the divide shrank by 11 percentage points and in the second case it shrank by 5 percentage points, these gains seem almost trivial in an instance where the digital divide is so huge. Already it appears as though this divide is much more of a problem than was the divide with respect to computer ownership, and illustrates that much of the focus on expanding the Internet should be placed on those households with combined annual incomes of less than $40,000.

The next set of variables, those addressing education levels, are not too far behind in severity from the income variables, and also show very little gain over the three year term. I find that those individuals who had less than a high school diploma were 25 percentage points (55%) less likely to have home Internet access than those with greater than a high school diploma in 2000, whereas by 2003 they were 32 percentage points (52%) less likely to have home Internet access. The results were much the same for individuals who had the equivalent of a high school diploma. While they were 19 percentage points (42%) less likely to have home Internet access in 2000, they were 23 percentage points (38%) less likely by 2003. Again, the decrease in the divide by three percentage points in the first instance and four percentage points in the second instance, are quite small when compared with the overall divide as it relates to education level.

The race variables are continually of particular interest to legislators to ensure continued equal opportunity to all constituents in domestic society, and for good reason. The results in this set of variables, while not illustrating as substantial a divide as the income and education variables, still show that this digital divide is much larger than the previous one. Beginning with Black respondents, I found that they were 19 percentage

points (43%) less likely than white respondents to have home Internet in 2000 and still 15 percentage points (25%) less likely to have home Internet than White respondents by 2003. Similarly, Native American respondents began with a decreased probability of 21 percentage points (46%) in 2000 and showed an improvement of thirteen percentage points to a decreased probability of only 20 percentage points (33%) by 2003. Also, as was the case with the home computer ownership model, Hispanic respondents in this model started out with the lowest access rates, but made the greatest gains by 2003. This group showed a marked decrease in the divide of 30 percentage points –from 22 percentage points (49%) less likely to have home Internet than white respondents in 2000 to 12 percentage points (19%) less likely than white respondents in 2003. These results are similar to those found by Fairlie (2004). He did find however, that Asian respondents had higher home Internet access rates than did White respondents, whereas I found this portion insignificant. However, I did find nearly identical results to Fairlie's on Spanish-speaking homes. He found that Spanish-speaking homes were much less likely to have home Internet than were non-Spanish speaking homes, which my results confirmed. For example, I found that living in a Spanish-only speaking home in 2000 resulted in a decreased probability of having Internet access of 14 percentage points (32%), a number that increased by 2003 to 28 percentage points (45%). Therefore, although I found the divide to lessen with respect to race, it certainly widened for those [Hispanic] homes that only spoke Spanish.

Unfortunately, each of the results for the home Internet access model show that this facet of the digital divide is showing little improvement. Although the results from 2000 were dismal, the lack of results by 2003 was even more dismal. While nearly every

aspect of the divide with respect to home computer ownership was showing improvement, any decreases in this divide are simply overshadowed by the excessively large distributional differences. Our results showed that the divide with respect to home Internet access was the largest for households with annual incomes less than $40,000, and tremendously so for households with annual incomes less than $20,000. Likewise, households where the respondent had less than a high school education were equally behind in the digital revolution, while households where the respondent completed his or her high school education or equivalent were only slightly ahead. These results suggest that households with annual incomes greater than $40,000 and education levels higher than a high school diploma or equivalent are substantially more likely to have home Internet access than are households where the annual income and education level is less than these levels.

The results for this section were also dim with respect to minority race. Although there were decreases in the divide with respect to race, the results still show an extremely large digital divide. By 2003, White respondents were still more likely to have home Internet access than were Black, Native American and Hispanic respondents. And, as was the case in the previous model, households where only Spanish was spoken experienced a substantial increase in the digital divide.

Adding in these results to our analysis provides us with a much better look at the digital divide. Were we to only consider the results with respect to home computer ownership, it would be feasible to imagine that the divide is not a large enough problem to require the attention it has received. However, after examining these results, it's a wonder it hasn't received even more attention. The next step then, before determining

our final conclusion on the digital divide, is to examine the divide with respect to broadband access and decide how that plays a role in equal opportunity to individuals in our society.

Section IV: Model Results for Broadband Internet Access

This final section is ultimately the reason for this entire research project. From the results in the second and third sections of the paper, it was obvious that there are deep-rooted demand side factors for the digital divide with respect to computer ownership and home Internet access. The final step then is relating this to the digital divide with respect to broadband Internet. This section follows the same methodology as the previous two models by testing the dependent variable –broadband access –against the same independent variables used in the computer ownership and home Internet access models. Due to this model being conditional on the respondents first answering that they have a home internet access, the total number of observations is lower for this model than for the previous two models, with 13,338 observations in 2000, 9,980 in 2001 and 11,415 in 2003. In 2000, 11.3% of the sampled population had home broadband Internet access, while the predicted mean was 10.9%. By 2001 19.1% of respondents had home broadband Internet access and 10.9% were predicted to, and by 2003 40.1% had home broadband Internet access, while 39.1% were predicted to have such access. Noting the average mean here shows that the number of respondents with broadband Internet access rose by almost 30 percentage points in three years.[12] As compared with our earlier analysis (where there was a rise of 10 percentage points for computer ownership and 20 percentage points for home Internet access), it is reasonable to assume that each successive section in this study has resulted in almost perfectly lagged growth results in

[12] Neilsen/NetRatings stated that from 2003-2004 there was an increase of 12 percentage points for broadband composition, from 2004-2005 there was an increase of 10 percentage points, and from 2005-2006 there was an increase of 13 percentage points. Although these numbers are among active Internet users, it still corresponds nicely to the numbers of US households estimated here.

the divide. The following analysis will illustrate that the divide with respect to broadband Internet is shrinking, but still affects those in non-metropolitan areas, those without a college education, those with annual incomes under $40,000 and those of minority races the most.

Out of all the included variables, the broadband digital divide seems to be observed in non-metropolitan areas the most. This would include those in rural areas, defined as anyone outside of the central city or balancing on the outskirts of a central city. Certainly this result speaks loudly for the supply-side argument that the divide has roots in that side as well. According to a government study, in 2003 only 24.7 percent of households in rural areas had broadband Internet access, as compared to 40.4 percent of households in urban areas (NTIA, 2004). Similarly, Prieger (2003) also concluded that a rural location decreases broadband availability, while education and Spanish language use (among other variables) increased availability. I will return to address these latter two variables later and will concentrate on the rural location variable for the moment. Following these models and my previous two models, I also included metropolitan variables in the broadband model to determine what happened over the years of consideration. As might be suspected from those believing that supply issues are at fault at this point in time in this divide, the results for metropolitan region were significant at the 1% level for all three years and grew increasingly negative from 2000 to 2003. In the results from this section I will pay considerably more attention to the percentage difference as it is derived by dividing the marginal effect by the probability of having home broadband Internet access. Though this was useful in the previous two models, but not necessary, in this model it becomes necessary to grant this number more attention.

The reason for this is that the average probability of having broadband access grew substantially by October 2003, and by a much greater percentage than did the variable observations under consideration. The variable for metropolitan area is an example of an instance where it can be misleading to simply look at the marginal effect rather than at the percent difference. I found that in 2000, households living on the border of a metropolitan area were 5.6 percentage points more likely to have broadband Internet than households in non-metropolitan areas. Comparing this with the average home broadband access probability of 11% for 2000 translates into a 50% difference. By 2003, the results show that households living on the border of a metropolitan area were now 24 percentage points more likely to have home Broadband access than were households in non-metropolitan areas. However, comparing this to the 40% average probability of having home broadband access for 2003, translates into a nearly 60% difference between those bordering on a metropolitan area and those non-metropolitan located households. . The results are predictably even more staggering for those households located within the central city area. In 2000 these households were 7 percentage points more likely to have broadband Internet than households living in a non-metropolitan area, which when compared with the average home broadband access probability of 11% translates into a 62% difference. By 2003 this number had increased to 26 percentage points, which translates into a 66% difference when compared with that year's average home broadband access probability of 40%. After metropolitan location, family income provided the second most significant result. As intuition would suggest, I found that households with incomes under $40,000 are significantly less likely to have broadband Internet as compared to those households with annual incomes over $40,000. More

specifically, I found that in 2001 households with annual incomes under $20,000 were 4 percentage points less likely to have broadband Internet than those with incomes above $40,000, which when compared to the average home broadband access probability of 19% translates into a 22% difference. By 2003 this number rose to a decreased probability of 7 percentage points, but when compared to the average home broadband access probability of 40% translates into an 18% difference. Similar results occurred in those households with incomes between $20,000 and $39,000. Note that while it might be expected that those in the least income range would have a lesser likelihood of obtaining broadband Internet, the results indicate that by 2003 the higher likelihood of the two low levels is actually the lowest range. Similar results occur with the variables for education level.

As might be expected by this point, the education variables are also significantly large, ranking third in magnitude for the purpose of this study. Again, take note of the percent difference as it compares to the average probability of having home broadband Internet. I find that in 2001, household heads with an education level of less than high school diploma or equivalent were 4 percentage points (22%) less likely to have broadband Internet than those with more than a high school diploma and by 2003 they were 7 percentage points (18%) less likely. As with those households with incomes between $20,000 and $39,000, I found that those with a high school diploma or equivalent were only 2 percentage points (16%) less likely than those making greater than $40,000 annually to have broadband Internet in 2000, but this number increased to 7 percentage points (18%) less likely by 2003. Most likely, this is indicative of supply increasing more rapidly in areas where higher educated residents reside.

The next characteristic I include in my explanation of this model is race. These numbers are extremely large, and although only some of them were significant they showed similar magnitude to the previous two models. For example, I found the Native American households to be significant only in 2001, with those households 11 percentage points less likely to have broadband Internet than White households – which, when compared with the average home broadband access rate of 19% translates into a 57% difference. Although this is by far the greatest number out of the race variables, it loses significance by 2003 and we are unable to see the trend line over time. In 2003 I found Asian households significant, with those households 7 percentage points (16%) more likely to have broadband Internet than White households. Although previous literature suggests that only Asian and Native American households have unequal availability and that "the case to be made for discrimination (profit-based or otherwise) against any other racial or ethnic group is very weak," I found instead that Black and Hispanic households also have results suggesting unequal home access rates (Prieger, 2003). For example, in 2001 Black households were 3 percentage points (17%) less likely to have broadband Internet than White households at a 10% significance level, while in 2003 they were 7 percentage points (18%) less likely to have broadband Internet than White households at a 1% significance level. Similarly, Hispanic households were 3 percentage points (15%) less likely to have broadband Internet than White households in 2001 at a 10% significance level, while in 2003 they were 9 percentage points (23%) less likely at a 1% significance level. It is prudent to note that although in the past two models Hispanic respondents experienced great gains in closing the digital gap, in this model such gains are not realized.

Finally the last factor I examine is respondent's region of the country. The specific variables of import in this section are Northeast and West; that is, explaining the relationship the households in the Northeast and West have as compared with the South.[13] I found that in 2001, households in the Northeast region of the country experienced an increased probability of having broadband Internet of 3 percentage points (18%) over those households in the South. However, by 2003 they were 5 percentage points more likely, which when compared to the average probability of 40% translates into a 13% difference. Similarly, I found that those households in the Western region were 2 percentage points less likely to have broadband Internet than those households in the South in 2000, which translates into a 20% difference when compared to the average home broadband access probability of 11%. Then, although these households in the Western region are nearly 4 percentage points more likely than households in the Southern region to have home broadband Internet access in 2001 and 2003, when compared with the home broadband access probabilities of 19% and 40% for these two years, this translates into a difference of 20% and 10%, respectfully.

Again, the results from this section provide little hope for a quick solution to the digital divide. While it is true that broadband Internet access across the country is increasing rapidly, it is not immediately clear that the digital divide with respect to broadband usage is decreasing. A selection model would be necessary to determine the results of any movement in this divide. We do however, see that households in non-metropolitan areas are increasingly left out of the digital revolution, as households in and

[13] We also considered Midwest, but found that with the exception of 10% significance only in 2000, it was not significant.

near central city areas increasingly experience the benefits of broadband Internet, while those in rural areas are left with dial-up.

The results with regard to income level and education level varied. The largest differences between those with and without broadband Internet was for those in the middle income and middle education range, rather than the lowest range. However, it is likely that this is a direct result of the increased pool of individuals with home Internet access, and specifically an increase of those in the middle income range, rather than any indication of a widening divide.

With regard to race, I found that Asian respondents were the most likely to have broadband Internet, while the least likely by 2003 were Hispanic respondents. Region of the country showed that the least likely to have broadband Internet in 2000 were those households in the South and Midwest, but by 2003 there was not quite the substantial difference.

In closing, although region of the country and metropolitan status suggest a divide largely hinging on supply, race and income suggest one depending more upon demand side factors.

Conclusion

The results from the analysis of home computer ownership, home Internet access and broadband Internet access models prove that there are likely both demand side factors and supply side factors at force in the digital divide. Due to many low-cost options for computers, it is likely that any divide in the computer ownership section is a result of mostly demand side factors. However, the more concerning models of home Internet access and home broadband Internet access surely result from both demand and supply-side factors. Potential supply side factors for these markets are, in the first case the availability of acceptable, low-cost internet access, whereas in the second case it's likely a lack of options for broadband Internet access.

In the case of home computer ownership, the most influential variables were income, education, race, marital status, and region. In this case intuitively sound results were achieved –that is, that low-income, low-educated households are less likely to have a home computer than are households where the annual income in greater than $40,000 and where the respondents have more than a high school education. The results also showed that White respondents were more likely to claim home computer ownership than were other race groups, although Hispanic households experienced a great decrease in the divide by 2003. This case was by far the most promising of the three as the divide was clearly shrinking over the period of three years.

The results for home Internet access did not quite paint the optimistic picture as did the first model, but was not the worst news of the study. Instead, this model showed that the divide was in fact extremely large, although there were still some small decreases in the divide. Again, I found here that low-income, low-educated households were less

likely to have home Internet access than were respondents with more education than a high school diploma, making more money than $40,000 a year. I also found that White respondents were more likely to claim home Internet than were Black, Native American or Hispanic respondents. Finally, although the overabundance of low-cost options in the previous section enabled the ruling out of a significant divide based off supply side failures, here the demographic and socioeconomic characteristics of the amazingly large divide do not afford the option of ruling out demand side failures.

Finally, the broadband Internet access results are inconclusive as they relate to any shifting of the overall digital divide. Due to an increasing pool in the sample for this portion of the study, it might at first appear as though there is a widening in the digital divide. However, this appearance is likely attributed to an increased number of first-time home Internet customers who choose dial-up services rather than broadband services. The results in this paper do not reveal anything about movements in the digital divide between those who do not have Internet access and those with broadband Internet access. Statements can be made as to the factors influencing the divide between those who choose dial-up Internet and those who choose broadband Internet. The results from this section showed that those in the Western and Northeastern regions are more likely to have home broadband Internet access than those in the South and Midwest, and those with higher incomes and higher education levels are more likely to have home broadband Internet than are those in lower income and lower education classes. Additionally, Black and Hispanic households are less likely to have broadband than are White or Asian households. Here the metropolitan area difference in access helps ensure an even better

argument for supply-side failures, though racial demographics along with socio-economic characteristics pave the way for demand-side failures as well.

Although price data was not available for this study, such data would only provide a more detailed look into the factors of the divide. Even yet, it is obvious that this portion of the divide is neither purely supply driven nor purely demand driven. As such, legislators can either wait twenty-plus years for this divide to slowly dissipate as has the majority of the computer ownership divide, or they could focus on a myriad of solutions including the implementation of a broadband Internet system to ensure rapid distribution of broadband access.

Combining all of the above results together provides the foundation for an in-depth look into both the supply-side determinants and demand-side determinants of the digital divide. As for government interaction, the results from all three sections suggest that the only arena in which interaction would have an effect is that with respect to education. Certainly increases in the income level would suggest increases in home computer ownership levels, as well as home Internet access levels and home broadband Internet access levels. However, since income levels are only measured by $20,000 intervals, and it is not feasible for the government to increase income levels to where all households have combined income greater than $40,000, no reasonable statement can be made as to providing subsidies intended to increase income levels. Likewise, although the results show certain racial difference between those with and without broadband Internet, no recommendation could be made with respect to changing respondent race either. Therefore, the last two possible arenas for government intervention are support

for increased education levels and support for a more inclusive broadband network reaching to those in non-metropolitan areas.

To conclude, even as much as has been discovered about the temporal effects of the digital divide in this study, there is still much work needed on this subject to ensure more understanding and a more equal distribution of services. The next step for a more in-depth look into this issue involves using a model to determine the inner workings of this digital divide –most notably the divide with respect to different *types* of broadband access.

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Appendix

Table 1.1. Variable Definitions.

Variable	Definition	Value
computer	Computer in household	1 if yes, 0 if no
homeinternet	Internet in household	1 if yes, 0 if no
bb_vs_dial	Broadband or Dial-up internet connection	1 if broadband, 0 if no
phone	Phone in household	1 if yes, 0 if no
renthome	Home rented for cash	1 if yes, 0 if no
neither own nor rent	Neither own home nor rent for cash	1 if yes, 0 if no
number in family	Number of members in household	Number
income under 20K	The household's total family income is under $20,000 annually	1 if yes, 0 if no
income b/t 20K & 39K	The household's total family income is between $20,000 and 39,999 annually	1 if yes, 0 if no
spanishonly	Spanish only language spoken in household	1 if yes, 0 if no
divorced	Respondent's marital status equals divorced	1 if yes, 0 if no
widowed	Respondent's marital status equals widowed	1 if yes, 0 if no
never married	Respondent has never been married	1 if yes, 0 if no
male	Respondent is male	1 if yes, 0 if no
black	Respondent is black	1 if yes, 0 if no
native american	Respondent is native american	1 if yes, 0 if no
asian	Respondent is asian	1 if yes, 0 if no
hispanic	Respondent is hispanic	1 if yes, 0 if no
age	Respondent's age	age in years
unemployed	Respondent is unemployed	1 if yes, 0 if no
not in labor force	Respondent is not in the labor force	1 if yes, 0 if no
central city	The location of the household is in the central city	1 if yes, 0 if no
nonmetro	The location of the household in a non-metropolitan area	1 if yes, 0 if no
noidMSA	The location of the household is not identified	1 if yes, 0 if no
northeast	The region of the household is in the northeast United States	1 if yes, 0 if no
midwest	The region of the household is in the midwest United States	1 if yes, 0 if no
west	The region of the household is in the western United States	1 if yes, 0 if no
less than high school	Less education than high school diploma or equivalent	1 if yes, 0 if no
high school	Education equal to high school diploma or equivalent	1 if yes, 0 if no

Table 1.2. Computer Ownership Summary Statistics.

	Aug 2000	Sep 2001	Oct 2003
N	28011	17198	18283
Pseudo R^2	0.2608	0.2461	0.2924
Actual Mean	0.5788	0.6539	0.6880
Predicted Mean	0.5950	0.6961	0.7534
computer	0.5788	0.6539	0.6880
	0.4938	*0.4757*	*0.4633*
phone	0.9721	0.9685	0.9756
	0.1647	*0.1747*	*0.1543*
renthome	0.2513	0.2426	0.2375
	0.4337	*0.4287*	*0.4256*
neither own nor rent	0.0116	0.0151	0.0137
	0.1069	*0.1220*	*0.1164*
number in family	2.9810	3.0973	2.8419
	1.5178	*1.5839*	*1.4603*
income under 20K	0.2059	0.1841	0.1896
	0.4044	*0.3876*	*0.3920*
income b/t 20K & 39K	0.2751	0.2752	0.2612
	0.4466	*0.4466*	*0.4393*
spanishonly	0.0280	0.0274	0.0278
	0.1649	*0.1634*	*0.1645*
divorced	0.1118	0.1125	0.1212
	0.3152	*0.3159*	*0.3264*
widowed	0.0725	0.0589	0.0762
	0.2593	*0.2354*	*0.2653*
never married	0.2459	0.2672	0.2506
	0.4306	*0.4425*	*0.4334*
male	0.4684	0.4794	0.4719
	0.4990	*0.4996*	*0.4992*
black	0.0937	0.8088	0.0913
	0.2914	*0.2727*	*0.2880*
native american	0.0125	0.0158	0.0065
	0.1111	*0.1245*	*0.0801*
asian	0.0341	0.0406	0.0310
	0.1815	*0.1973*	*0.1734*
hispanic	0.0896	0.0929	0.0796
	0.2857	*0.2902*	*0.2707*
age	45.5619	43.3657	46.5464
	18.8303	*17.9802*	*18.4329*
unemployed	0.0288	0.0324	0.0339
	0.1674	*0.1772*	*0.1810*
not in labor force	0.3528	0.3137	0.3639
	0.4778	*0.4640*	*0.4811*
central city	0.2394	0.2171	0.2137
	0.4267	*0.4123*	*0.4099*
balance on MSA	0.3971	0.3255	0.3860
	0.4893	*0.4686*	*0.4868*
noidMSA	0.1473	0.1753	0.1802
	0.3544	*0.3802*	*0.3843*
northeast	0.2208	0.1635	0.3059
	0.4148	*0.3698*	*0.4608*
midwest	0.2385	0.2820	0.2110
	0.4262	*0.4500*	*0.4080*
west	0.2509	0.2932	0.1735
	0.4336	*0.4552*	*0.3787*
less than high school	0.2070	0.1967	0.1890
	0.4052	*0.3975*	*0.3915*
high school	0.3037	0.3033	0.3141
	0.4599	*0.4597*	*0.4642*

The results are in order of mean followed by the italicized standard deviation.

Table 1.3 Home Internet Access Summary Statistics.

	Aug 2000	Sep 2001	Oct 2003
N	28011	17198	18283
Pseudo R^2	0.2274	0.2395	0.2769
Actual Mean	0.4624	0.5803	0.6244
Predicted Mean	0.4276	0.5923	0.6636
homeinternet	0.4624	0.5803	0.6244
	0.4986	*0.4935*	*0.4843*
phone	0.9721	0.9685	0.9756
	0.1647	*0.1747*	*0.1543*
renthome	0.2513	0.2426	0.2375
	0.4337	*0.4287*	*0.4256*
neither own nor rent	0.0116	0.0151	0.0137
	0.1069	*0.1220*	*0.1164*
number in family	2.9810	3.0973	2.8419
	1.5178	*1.5839*	*1.4603*
income under 20K	0.2059	0.1841	0.1896
	0.4044	*0.3876*	*0.3920*
income b/t 20K & 39K	0.2751	0.2752	0.2612
	0.4466	*0.4466*	*0.4393*
spanishonly	0.0280	0.0274	0.0278
	0.1649	*0.1634*	*0.1645*
divorced	0.1118	0.1125	0.1212
	0.3152	*0.3159*	*0.3264*
widowed	0.0725	0.0589	0.0762
	0.2593	*0.2354*	*0.2653*
never married	0.2459	0.2672	0.2506
	0.4306	*0.4423*	*0.4334*
male	0.4684	0.4794	0.4719
	0.4990	*0.4996*	*0.4992*
black	0.0937	0.8088	0.0913
	0.2914	*0.2727*	*0.2880*
native american	0.0125	0.0158	0.0065
	0.1111	*0.1245*	*0.0801*
asian	0.0341	0.0406	0.0310
	0.1815	*0.1973*	*0.1734*
hispanic	0.0896	0.0929	0.0796
	0.2857	*0.2902*	*0.2707*
age	45.5619	43.3657	46.5464
	18.8330	*17.9802*	*18.4329*
unemployed	0.0288	0.0324	0.0339
	0.1674	*0.1772*	*0.1810*
not in labor force	0.3528	0.3137	0.3639
	0.4778	*0.4640*	*0.4811*
central city	0.2394	0.2171	0.2137
	0.4267	*0.4123*	*0.4099*
balance on MSA	0.3971	0.3255	0.3860
	0.4893	*0.4686*	*0.4868*
noidMSA	0.1473	0.1753	0.1802
	0.3544	*0.3802*	*0.3843*
northeast	0.2208	0.1635	0.3059
	0.4148	*0.3698*	*0.4608*
midwest	0.2385	0.2820	0.2110
	0.4262	*0.4500*	*0.4080*
west	0.2509	0.2932	0.1735
	0.4336	*0.4552*	*0.3787*
less than high school	0.2070	0.1967	0.1890
	0.4052	*0.3975*	*0.3915*
high school	0.3037	0.3033	0.3141
	0.4599	*0.4597*	*0.4642*

The results are in order of mean followed by the italicized standard deviation.

Table 1.4. Broadband Internet Access Summary Statistics.

	Aug 2000	Sep 2001	Oct 2003
N	13338	9980	11415
Pseudo R^2	0.0146	0.0379	0.0549
Actual Mean	0.1133	0.1912	0.4014
Predicted Mean	0.1089	0.1782	0.3911
broadband	0.1133	0.1912	0.4014
	0.3170	*0.3933*	*0.4902*
phone	0.9894	0.9924	0.9907
	0.1023	*0.0869*	*0.0960*
renthome	0.1683	0.1779	0.1756
	0.3742	*0.3824*	*0.3805*
neither own nor rent	0.0091	0.0090	0.0098
	0.0952	*0.0945*	*0.0986*
number in family	3.2193	3.3160	3.0915
	1.3670	*1.4666*	*1.3893*
income under 20K	0.0618	0.0699	0.0787
	0.2408	*0.2551*	*0.2692*
income b/t 20K & 39K	0.1999	0.2055	0.1999
	0.3999	*0.4041*	*0.4000*
spanishonly	0.0098	0.0130	0.0110
	0.0986	*0.1134*	*0.1045*
divorced	0.0837	0.0864	0.0972
	0.2769	*0.2809*	*0.2963*
widowed	0.0259	0.0232	0.0339
	0.1590	*0.1507*	*0.1810*
never married	0.2476	0.2621	0.2497
	0.4317	*0.4398*	*0.2438*
male	0.4867	0.4880	0.4811
	0.4998	*0.4999*	*0.4997*
black	0.0492	0.0491	0.0625
	0.2163	*0.2161*	*0.2422*
native american	0.0063	0.0106	0.0054
	0.0791	*0.1025*	*0.0054*
asian	0.0423	0.0488	0.0386
	0.2012	*0.2155*	*0.1927*
hispanic	0.0472	0.0593	0.0549
	0.2120	*0.2362*	*0.2278*
age	41.3624	40.5372	43.0484
	15.8941	*15.7289*	*16.3732*
unemployed	0.0273	0.0280	0.0330
	0.1629	*0.1649*	*0.1787*
not in labor force	0.2460	0.2449	0.2739
	0.4307	*0.4300*	*0.4460*
central city	0.2165	0.2037	0.1862
	0.4119	*0.4028*	*0.3893*
balance on MSA	0.4599	0.3720	0.4303
	0.4984	*0.4834*	*0.4951*
noidMSA	0.1508	0.1818	0.1912
	0.3579	*0.3857*	*0.3932*
northeast	0.2286	0.1821	0.3212
	0.4199	*0.3859*	*0.4669*
midwest	0.2372	0.2735	0.2128
	0.4254	*0.4458*	*0.4093*
west	0.2765	0.3093	0.1836
	0.4473	*0.4622*	*0.3872*
less than high school	0.1084	0.1307	0.1170
	0.3109	*0.3370*	*0.3215*
high school	0.2317	0.2488	0.2591
	0.4220	*0.4323*	*0.4382*

The results are in order of mean followed by the italicized standard deviation.

Table 2.1. Computer Ownership Coefficients, Standard Errors and Marginal Effects.

		Aug 2000	Sept 2001	Oct 2003
Dependent Variable	own computer			
Independent Variable	phone	**0.7839** ***	**1.0194** ***	**1.0155** ***
		0.0992	*0.1169*	*0.1255*
		0.1935	0.2424	0.2265
	renthome	**-0.5579** ***	**-0.4826** ***	**-0.5781** ***
		0.0380	*0.0488*	*0.0503*
		-0.1365	-0.1065	-0.1152
	neither own nor rent	-0.0246	**-0.5094** ***	**-0.3952** **
		0.1367	*0.1535*	*0.1655*
		-0.0059	-0.1167	-0.0803
	number in family	**0.1479** ***	**0.1374** ***	**0.2178** ***
		0.0120	*0.0148*	*0.0174*
		0.0356	0.0291	0.0405
	income under 20K	**-1.4476** ***	**-1.4750** ***	**-1.4207** ***
		0.0452	*0.0574*	*0.0582*
		-0.3468	-0.3429	-0.3086
	income b/t 20K & 39K	**-0.9573** ***	**-1.0453** ***	**-0.9191** ***
		0.0344	*0.0451*	*0.0471*
		-0.2333	-0.2356	-0.1875
	spanishonly	**-0.7932** ***	**-0.4021** ***	**-1.4018** ***
		0.1040	*0.1238*	*0.1319*
		-0.1957	-0.0907	-0.3218
	divorced	**-0.1754** ***	**-0.2680** ***	**-0.3096** ***
		0.0488	*0.0616*	*0.0621*
		-0.0427	-0.0589	-0.0609
	widowed	**-0.2628** ***	**-0.5573** ***	**-0.2533** ***
		0.0680	*0.0907*	*0.0781*
		-0.0644	-0.1275	-0.0496
	never married	**-0.2941** ***	**-0.3851** ***	**-0.5561** ***
		0.0451	*0.0582*	*0.0624*
		-0.0717	-0.0841	-0.1102
	male	-0.0430	**-0.0682** *	**-0.0805** **
		0.0304	*0.0393*	*0.0405*
		-0.0104	-0.0144	-0.0150
	black	**-0.6380** ***	**-0.7473** ***	**-0.7134** ***
		0.0539	*0.0713*	*0.0679*
		-0.1576	-0.1733	-0.1503
	native american	**-0.7663** ***	**-0.8323** ***	-0.0473
		0.1316	*0.1486*	*0.2305*
		-0.1893	-0.1965	-0.0089
	asian	**-0.1840** **	0.0980	0.2090
		0.0830	*0.1058*	*0.1338*
		-0.0450	0.0204	0.0369
	hispanic	**-0.9038** ***	**-0.8418** ***	**-0.4250** ***
		0.0579	*0.0718*	*0.0817*
		-0.2222	-0.1965	-0.0858

Table 2.1. Continued.

		Aug 2000	Sept 2001	Oct 2003
Independent Variable	age	**-0.0292** ***	**-0.0276** ***	**-0.0357** ***
		0.0012	*0.0016*	*0.0017*
		-0.0070	-0.0058	-0.0066
	unemployed	-0.0390	**-0.2013** *	0.1656
		0.0865	*0.1045*	*0.1077*
		-0.0094	-0.0441	0.0295
	not in labor force	**-0.1073** ***	**-0.1045** **	**-0.1587** ***
		0.0361	*0.0466*	*0.0472*
		-0.0259	-0.0223	-0.0298
	central city	**0.1389** ***	0.0787	0.0799
		0.0461	*0.0572*	*0.0617*
		0.0332	0.0165	0.0147
	balance on MSA	**0.3255** ***	**0.1803** ***	**0.1849** ***
		0.0404	*0.0511*	*0.0536*
		0.0778	0.0377	0.0340
	noidMSA	**0.2615** ***	**0.1994** ***	**0.2435** ***
		0.0498	*0.0585*	*0.0630*
		0.0617	0.0411	0.0434
	northeast	0.0593	**0.4498** ***	**0.2182** ***
		0.0422	*0.0625*	*0.0512*
		0.0142	0.0891	0.0397
	midwest	**0.0842** **	**0.0905** *	0.0049
		0.0409	*0.0520*	*0.0559*
		0.0202	0.0190	0.0009
	west	**0.3846** ***	**0.3537** ***	**0.1723** ***
		0.0415	*0.0537*	*0.0614*
		0.0906	0.0726	0.0311
	less than high school	**-1.2592** ***	**-1.0422** ***	**-1.4434** ***
		0.0442	*0.0568*	*0.0579*
		-0.3048	-0.2398	-0.3140
	high school	**-0.9286** ***	**-0.8567** ***	**-1.0514** ***
		0.0337	*0.0442*	*0.0455*
		-0.2259	-0.1904	-0.2119
	constant	**1.7743** ***	**1.8446** ***	**0.2610** ***
		0.1319	*0.1623*	*0.1749*

*, **, and *** indicates level of significance at the 10%, 5%, and 1% level, respectively
The results are in order of coefficient, standard error and marginal effect.

Table 2.2. Home Internet Access Coefficients, Standard Errors and Marginal Effects.

		Aug 2000	Sept 2001	Oct 2003
Dependent Variable	home internet			
Independent Variable	phone	**0.8244** ***	**1.3474** ***	**0.9810** ***
		0.1101	*0.1383*	*0.1328*
		0.1822	0.3199	0.2379
	renthome	**-0.3951** ***	**-0.4222** ***	**-0.4597** ***
		0.0382	*0.0482*	*0.0486*
		-0.0948	-0.1034	-0.1060
	neither own nor rent	0.1092	**-0.6011** ***	**-0.3324** **
		0.1378	*0.1583*	*0.1625*
		0.0269	-0.1489	-0.0776
	number in family	**0.0717** ***	**0.0988** ***	**0.2040** ***
		0.0115	*0.0140*	*0.0162*
		0.0175	0.0239	0.0455
	income under 20K	**-1.5333** ***	**-1.6497** ***	**-1.5466** ***
		0.0489	*0.0584*	*0.0571*
		-0.3250	-0.3887	-0.3653
	income b/t 20K & 39K	**-0.8742** ***	**-1.0363** ***	**-1.0270** ***
		0.0335	*0.0428*	*0.0440*
		-0.2033	-0.2523	-0.2405
	spanishonly	**-0.6523** ***	**-0.4942** ***	**-1.1681** ***
		0.1152	*0.1308*	*0.1352*
		-0.1483	-0.1223	-0.2829
	divorced	**-0.2370** ***	**-0.3100** ***	**-0.2893** ***
		0.0489	*0.0608*	*0.0597*
		-0.0571	-0.0761	-0.0667
	widowed	**-0.2764** ***	**-0.6005** ***	**-0.3562** ***
		0.0739	*0.0951*	*0.0800*
		-0.0662	-0.1486	-0.0829
	never married	**-0.2980** ***	**-0.3537** ***	**-0.4331** ***
		0.0434	*0.0561*	*0.0586*
		-0.0719	-0.0864	-0.0996
	male	-0.0156	-0.0444	-0.0506
		0.0291	*0.0378*	*0.0383*
		-0.0038	-0.0107	-0.0113
	black	**-0.8866** ***	**-0.7804** ***	**-0.6510** ***
		0.0568	*0.0722*	*0.0668*
		-0.1974	-0.1926	-0.1548
	native american	**-0.9905** ***	**-0.6673** ***	-0.1147
		0.1437	*0.1510*	*0.2201*
		-0.2113	-0.1652	-0.2061
	asian	-0.0305	0.1547	0.1987
		0.0776	*0.0997*	*0.1214*
		-0.0074	0.0368	0.0429
	hispanic	**-1.0532** ***	**-0.8858** ***	**-0.5097** ***
		0.0601	*0.0716*	*0.0788*
		-0.2282	-0.2179	-0.1202

Table 2.2. Continued.

		Aug 2000	Sept 2001	Oct 2003
Independent Variable	age	**-0.0281** ***	**-0.0257** ***	**-0.0298** ***
		0.0012	*0.0016*	*0.0016*
		-0.0069	-0.0062	-0.0067
	unemployed	0.0312	-0.1322	0.1128
		0.0854	*0.1039*	*0.1016*
		0.0076	-0.0322	0.0247
	not in labor force	-0.0378	0.0091	-0.0526
		0.0355	*0.0457*	*0.0454*
		-0.0092	0.0022	-0.0118
	central city	**0.2950** ***	**0.2504** **	**0.1663** ***
		0.0486	*0.0555*	*0.0590*
		0.0728	0.0595	0.0365
	balance on MSA	**0.3603** ***	**0.3693** ***	**0.3626** ***
		0.0391	*0.0489*	*0.0508*
		0.0884	0.0878	0.0797
	noidMSA	**0.3428** ***	**0.3394** ***	**0.4171** ***
		0.0486	*0.0563*	*0.0599*
		0.0849	0.0799	0.0886
	northeast	**0.0829** **	**0.3689** ***	**0.2431** ***
		0.0408	*0.0600*	*0.0488*
		0.0204	0.0866	0.0534
	midwest	**-0.0744** *	-0.0478	0.0420
		0.0397	*0.0505*	*0.0534*
		-0.0182	-0.0116	0.0093
	west	**0.2759** ***	**0.2562** ***	**0.1497** ***
		0.0398	*0.0520*	*0.0579*
		0.0680	0.0612	0.0329
	less than high school	**-1.1331** ***	**-0.9766** ***	**-1.3611** ***
		0.0450	*0.0563*	*0.0565*
		-0.2525	-0.2391	-0.3230
	high school	**-0.8378** ***	**-0.8041** ***	**-1.0211** ***
		0.0324	*0.0422*	*0.0427*
		-0.1965	-0.1962	-0.2363
	constant	**1.1321** ***	**1.0080** ***	**1.7614** ***
		0.1389	*0.1749*	*0.1751*

*, **, and *** indicates level of significance at the 10%, 5%, and 1% level, respectively
The results are in order of coefficient, standard error and marginal effect.

Table 2.3. Broadband Internet Access Coefficients, Standard Errors and Marginal Effects.

		Aug 2000	Sept 2001	Oct 2003
Dependent Variable	broadband vs dial-up			
Independent Variable	phone	**-0.5762** ***	0.0289	0.2518
		0.2246	*0.3147*	*0.2119*
		-0.0694	0.0042	0.0581
	renthome	**-0.1648** **	-0.0160	0.0474
		0.0834	*0.0756*	*0.0587*
		-0.0153	-0.0023	0.0113
	neither own nor rent	**-0.8402** **	-0.0640	**-0.5754** **
		0.4229	*0.3120*	*0.2287*
		-0.0592	-0.0092	-0.1259
	number in family	-0.0095	**0.0574** ***	0.0042
		0.0231	*0.0194*	*0.0165*
		-0.0009	0.0084	0.0010
	income under 20K	0.0367	**-0.3274** ***	**-0.3092** ***
		0.1278	*0.1208*	*0.0839*
		0.0036	-0.0437	-0.0712
	income b/t 20K & 39K	-0.0871	**-0.2424** ***	**-0.4572** ***
		0.0769	*0.0740*	*0.0555*
		-0.0083	-0.0339	-0.1049
	spanishonly	**-0.6301** *	-0.0328	-0.1281
		0.3691	*0.2298*	*0.2033*
		-0.0480	-0.0048	-0.0301
	divorced	**0.1802** *	0.1320	-0.0329
		0.1003	*0.0988*	*0.0724*
		0.0185	0.0200	-0.0078
	widowed	**-0.3980** *	**0.5657** ***	0.1103
		0.2324	*0.1707*	*0.1236*
		-0.0333	0.0974	0.0265
	never married	**-0.2147** **	**0.2051** ***	0.0222
		0.0871	*0.0802*	*0.0628*
		-0.0200	0.0310	0.0053
	male	0.0521	0.0688	**0.1214** ***
		0.0565	*0.0531*	*0.0403*
		0.0051	0.0101	0.0289
	black	-0.0764	**-0.2336** *	**-0.3060** ***
		0.1304	*0.1260*	*0.0858*
		-0.0072	-0.0319	-0.0704
	native american	-0.1380	**-1.0557** ***	0.2199
		0.3986	*0.3744*	*0.2697*
		-0.0127	-0.1090	0.0534
	asian	0.1342	0.1173	**0.2673** ***
		0.1291	*0.1114*	*0.1021*
		0.0137	0.0178	0.0651
	hispanic	-0.1454	**-0.2118** *	**-0.4166** ***
		0.1404	*0.1158*	*0.0949*
		-0.0134	-0.0292	-0.0943

Table 2.3. Continued.

		Aug 2000	Sept 2001	Oct 2003
Independent Variable	age	**-0.0103** ***	-0.0039	**-0.0157** ***
		0.0026	*0.0025*	*0.0018*
		-0.0010	-0.0006	-0.0037
	unemployed	-0.1720	0.1685	**-0.2285** **
		0.1822	*0.1501*	*0.1139*
		-0.0157	0.0260	-0.0530
	not in labor force	0.0403	0.0062	-0.0715
		0.0712	*0.0676*	*0.0503*
		0.0039	0.0009	-0.0170
	central city	**0.6274** ***	**1.0988** ***	**1.0916** ***
		0.1035	*0.0894*	*0.0711*
		0.0701	0.1945	0.2657
	balance on MSA	**0.5714** ***	**0.9287** ***	**1.0142** ***
		0.0929	*0.0816*	*0.0607*
		0.0568	0.1468	0.2404
	noidMSA	**0.4952** ***	**0.7199** ***	**0.9180** ***
		0.1091	*0.0942*	*0.0694*
		0.0550	0.1212	0.2242
	northeast	0.0526	**0.2187** ***	**0.2173** ***
		0.0764	*0.0817*	*0.0518*
		0.0052	0.0335	0.0521
	midwest	**-0.1371** *	0.0019	-0.0629
		0.0791	*0.0770*	*0.0584*
		-0.0129	0.0003	-0.0149
	west	**-0.2377** ***	**0.2639** ***	**0.1591** ***
		0.0782	*0.0728*	*0.0613*
		-0.0221	0.0399	0.0383
	less than high school	-0.1589	**-0.3109** ***	**-0.3175** ***
		0.1064	*0.0935*	*0.0729*
		-0.0147	-0.0422	-0.0733
	high school	**-0.1897** ***	**-0.2367** ***	**-0.3044** ***
		0.0703	*0.0654*	*0.0479*
		-0.0177	-0.0334	-0.0711
	constant	**-1.3189** ***	**-2.3233** ***	**-0.7077** ***
		0.2875	*0.3527*	*0.2472*

*, **, and *** indicates level of significance at the 10%, 5%, and 1% level, respectively
The results are in order of coefficient, standard error and marginal effect.

Vita

Jennifer Lyn Blakley was born in Knoxville, TN on August 22, 1980. She was raised in Strawberry Plains, TN and went to school at Sunnyview Elementary, Carter Middle, and Carter High, graduating from the latter in 1998. Following that, she went to Walters State Community College, graduating with an A.S. in 2000. She then began studies at the University of Tennessee, graduating with a B.S. in Economics in 2003 and a M.A. in Economics in 2007.